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Temporal Isotope Variations in Glacial-Postglacial Lavas from Northern Iceland

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Temporal isotope variations in glacial-postglacial lavas from Northern Iceland

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In Iceland there is an important relationship between deglaciation and increased volcanism [e.g. 1, 2]. At the end of the last glacial period ~13, 000 years BP a large ice sheet covering Iceland rapidly melted in ~2, 000 years [3]. Volcanic eruption rates immediately after deglaciation were up to 100 times greater than in recent (~7, 000 year BP to present) and glacial times [2]. Geophysical models [1] suggest that rapid melting of the large ice sheet caused a transient increase in decompression mantle melting. Trace element data support this interpretation as primitive postglacial lavas have lower incompatible trace element concentrations than primitive glacial lavas [2]. However, the geophysical models [1] assume a uniform mantle source, which if a wrong assumption has major implications for melting processes beneath Iceland. To investigate the source of the postglacial lavas relative to the recent and glacial lavas, we have measured Sr, Nd, Hf, and Pb isotopes for 27 glacial lavas from the adjacent Theistareykir and Krafla rift zones in northern Iceland and for 4 historical lavas from Krafla. Our results indicate that the postglacial lavas at Theistareykir and Krafla are isotopically depleted relative to glacial and recent lavas. This suggests that the mantle underneath northern Iceland is heterogeneous on small scales within the melting column. We hypothesize that during deglaciation the melting rate increases more at the top than at the base of the melting region, so postglacial lavas are weighted towards melt compositions from the shallow, depleted mantle. Our data from northern Iceland illustrate the importance of the physical properties of the melting regime in filtering the signal of mantle heterogeneity: a large shift in the isotopic composition of erupted basalts need not correspond to a large shift in the composition of the mantle entering the melting region, only a change in the way the melting and melt transport samples the mantle.

[1] Jull & McKenzie (1996) *JGR* **101**: **21**, 815–21, 828. [2] Maclennan *et al.* (2002) *G*^{3} **3**(11), 1–25. [3] Norddahl *et al.* (2008) *Jökull* 58: 343–364.

The impact of marine organic emissions on global climate

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The emissions of primary organic matter (POM) of marine biogenic origin and secondary organic aerosol (SOA) from the oxidation of phytoplankton-produced volatile organic compounds (VOC) can lead to changes in chemical composition and size distribution of marine aerosol, cloud droplet number concentration (CDNC), coastal air quality and climate. Recent studies suggest that poor characterization of marine aerosols over remote regions, may contribute the major uncertainty in aerosol indirect effect. Here the global and the regional effects of marine biogenic trace gases and organic carbon (OC) aerosol emissions are explored using the NCAR Community Atmosphere Model (CAM), coupled with the PNNL Modal Aerosol Model (CAM-MAM) A 10 year CAM-MAM model simulations are conducted at a grid resolution 1.9°×2.5° with 26 vertical layers. Remotely-sensed chlorophyll-*a* concentration, laboratory measurements, and model meteorology are used to calculate marine emissions of isoprene and monoterpenes. Marine POM emissions in sub and super-micron modes are calculated by connecting organic mass fraction of sea spray with remotely-sensed wind speed and the sea surface concentration of dissolved organic carbon (DOC). Both sub and super-micron marine POM are assumed to be mostly water-insoluble, while marine SOA is assumed to be 50% water soluble.

Model-predicted relationship between ocean physical and biological systems and the abundance of cloud condensation nuclei (CCN) in remote marine atmosphere is tested using a novel approach by considering the differences between remotely sensed aerosol optical depth and predicted sea salt aerosol optical depth (AOD_{diff}). Data analysis are conducted at different retrieval wavelengths (550 and 1020 nm) and sea salt AOD parameterizations. Preliminary results show that different marine aerosol emissions and cloud droplet activation mechanisms yield 10%-20% increase in CDNC of global maritime shallow clouds. Changes associated with cloud properties raise short wave forcing by -0.3Wm^{-2} to -0.7 Wm^{-2}. By using different emission scenarios, SOA formation mechanisms, and droplet activation parameterizations, this study suggests that addition of marine primary aerosols and biologically generated reactive gases could reduce uncertainty in future global climate simulations.